

# Course Syllabus

## BIOC 313 Fall 2018 Syllabus

### General Course Description

In this **course-based undergraduate research experience (CURE)**, **students work in teams to design their own project, analyze data, and communicate their findings**. Students will read and present current literature that focuses on genetic parts that are currently used to program bacteria (sensors, logic functions, and actuators) and bacteria that have been successfully programmed to exhibit novel functions. The laboratory will expose students to molecular biological procedures that are routinely used in building and characterizing synthetic genetic circuits. Teams of students will choose, design, and test projects using synthetic biology in complex settings.

### Overarching AIMS of course

There are three threads in this CURE:

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1. **Literature:** you will read and present classic journal articles in synthetic biology as well as current articles with approaches and strategies for complex settings
2. **Creative Outlet:** you will work as a team to design, assemble, and test a microbial biosensor
3. **Experimentation:** in the second half of the semester, you will gain experience with fundamental methods of DNA assembly

### Laboratory Meetings

Scheduled meetings are from 1-4 pm in Anderson Biological Laboratories (ABL) 126 and self-scheduled at other times:

- *Mondays only* in the *first half* of the semester
- *Mondays and Wednesdays* in the *second half* of the semester

Our first meeting is Monday, 20-Aug-2018; labs begin on Wed., Oct. 10 and last scheduled day is Wed., 28-

Nov-2018.

### **Overview of Schedule:**

- **Aug. 20:** Course Introduction; Workshop on Journal Article Presentations, Dr. Jennifer Wilson, Director, Program in Writing and Communication (PWC)
- **Aug. 27:** ; Introduction of the state of genetic engineering and emerging challenges; Idea Day 1
- **Sept. 10:** Idea Day 2
- **Sept. 17:** Journal Club presentations; DNA design
- **Sept. 24:** Journal Club presentations; Peer review of DNA design
- **Oct. 1:** Journal Club presentations; Final DNA design
- **Oct. 10 - Nov. 28:** DNA assembly

See [PROJECT OVERVIEW and COURSE SCHEDULE](#) for detailed schedule.

## INSTRUCTOR

**Beth Beason-Abmayr** (<http://www.bioc.rice.edu/~bbeason/>) : email [bbeason@rice.edu](mailto:bbeason@rice.edu) (<mailto:bbeason@rice.edu>) to set-up an appointment; Anderson Biological Laboratories (ABL) 326

## COURSE OBJECTIVES AND LEARNING OUTCOMES

BIOC 313 advances laboratory, record keeping, and technical communication skills that were introduced in BIOC 211: Intermediate Experimental Biosciences. **You will work in teams to perform authentic research in synthetic biology. Overall learning goals and intended learning outcomes for the course are outlined below.** As you look over the BIOC 313 goals and specific objectives below, please consider which areas represent your strengths, in which areas you want to strengthen your skills, and in which areas you have little or no experience. Return to this list later in the class to assess for yourself whether you are progressing towards these goals.

### **Goal 1: Possess basic laboratory skills desired of an independent researcher**

Understanding the rationale behind procedures and asking questions that reflect a willingness to learn promote effective time management and successful completion of experiments. Our best students are always the ones who are engaged in the learning process. An independent researcher

- follows standard protocols to complete specific procedures
- adheres to instructions on laboratory safety, and recognizes hazardous situations and acts appropriately
- uses and stores equipment properly

- handles lab reagents and solutions sensibly
- performs basic lab calculations to prepare solutions and samples for experiments
- measures and reports uncertain quantities with appropriate precision
- applies appropriate methods of analysis to raw data
- converts raw data to a physically meaningful form with appropriate units

## **Goal 2: Understand the importance of effective communication and of detailed and accurate record keeping**

Communication and record keeping are fundamental to the dissemination of science. A student who is an effective communicator

- maintains a timely, comprehensive laboratory notebook with sufficient detail to repeat experiments, troubleshoot procedures, and analyze data
- shares information orally
- writes effectively in appropriate style and depth
- makes effective use of information resources

## **Goal 3: Recognize the importance of discipline and responsibility when working in a professional environment**

In addition to working independently, each student is expected to work well with each member of a team. A disciplined and responsible student

- employs all available resources to prepare for laboratory work
- takes the initiative to note when assignments are due and completes them on time
- follows instructions for completion of assignments and execution of lab procedures
- works independently but seeks help when appropriate
- works effectively as part of a team and divides lab responsibilities to complete work in a timely manner
- admits when mistakes or errors are made and accepts responsibility for actions
- learns from mistakes as well as successes and is open to suggestions from teammates, TAs, or the instructor
- recalls routine procedures without having to consult a teammate, TA, or instructor
- takes the initiative to refresh past understanding of methods, procedures, explanations, and theory
- shares specific observations and experiences with teammates
- when necessary, picks up responsibilities if partner is unable to carry them out

## **Goal 4: Experience that not all scientific experiments work as planned**

Many scientific experiments do not work as planned and often yield either no results or findings that conflict

with or differ from previous experiments. Our teaching labs in BioSciences provide a "safe" and nurturing environment where a student can

- respond to questions that require troubleshooting of experimental methods or data collection
- use laboratory notes and observations to evaluate the success of experiments and identify potential errors when outcomes are unanticipated
- make corrections or alterations after missteps in experimental procedures, adjusting their schedule or research plan appropriately
- observe how other students report errors in posters or presentations

### **Goal 5: Recognize appropriate context and understand how to report meaningful data**

Paying attention to detail is important not only in performing experimental procedures but also in reporting the results to the scientific community and the general public. A meticulous and focused student

- recognizes the relevance of data
- relates laboratory work to the bigger picture
- recognizes the applicability of scientific principles to real world situations
- considers how seemingly minor oversights or mistakes can have serious consequences

### **Goal 6: Recognize the importance of asking questions to help you understand a concept**

When exploring new fields, especially those that merge disciplines (like Biology and Engineering), it is normal to feel a little lost and even overwhelmed or embarrassed. Progress may feel a little slow at the beginning of this course because you may be learning the new language of synthetic biology: abstraction, circuit design, DNA assembly, standard parts, and more. A fearless student will

- not hesitate to ask *any* questions during class. What you may perceive as trivial actually might not be so simple, and many others in the class likely have the same question!
- give us feedback to help us judge how well we are communicating the material.
- question why a lab procedure is performed a certain way rather than just blindly follow a protocol.

## **Required Text and Resources**

- Victoria E. McMillan, *Writing Papers in the Biological Sciences*, Fifth Edition (2012) or Sixth Edition (2017), Bedford/St. Martin's
- Scientific research articles (links provided in Canvas Files)
- **Canvas**: supplemental resources and videos, reflections/quizzes, assignments, announcements, grade postings, and more

## **Required Materials**

- ballpoint pen (not felt-tip or gel)
- safety GLASSES (NOT goggles)
- computer

## Preparation

*In preparation for **class discussions and student presentations**, everyone is expected to read appropriate background material and assigned paper(s) (available in Canvas Files). See **How to Read a Scientific Article** (in Canvas Files) for tips on reading research papers. *Additionally, you must come to **lab** prepared* - this requires you to READ the experimental protocols BEFORE coming to lab, not just print a copy and bring it with you. For the detailed schedule, see OWL-Space and the course web site.*

### **For discussions:**

- Read over the material in Canvas and any additional materials and identify any questions for the instructor
- Watch the appropriate videos (links are in Canvas Files)
- Obtain necessary information about techniques from the resources provided
- Come to each lab prepared to answer questions and evaluate your knowledge about the techniques, safety issues, scientific theory, and experimental significance

### **For laboratory work:**

- Read the rules for safe conduct in the laboratory (see [Rice BioS\\_Lab safety and conduct.pdf](#) ) before the first lab session and be aware of special safety concerns for each lab meeting
- Use resources to ensure that you know what we are doing and why we are doing it
- Prepare an outline (procedure, notes, calculations) so that you are ready to perform labwork
- Complete and submit online pre-laboratory assignments before coming to lab sessions
- Record your prelaboratory calculations in your notebook when applicable
- *Take notes in your team lab notebook*: the lab notebook will remain in the lab at all times throughout the semester; at the end of each lab, designate a team member to take photos of the pages and upload them to your team page in Canvas.

### **Follow-up work:**

- Monitor assignment due dates each week to ensure that you are aware of upcoming assignments
- Check e-mail and Canvas Announcements frequently for new or updated class information

NOTE: You are responsible for printing procedure information and additional resources for each day of lab (i.e., there are no handouts). Please see Canvas for further details. Please bring your personal computer to lab with you.

## ATTENDANCE POLICIES

*Attendance at all laboratory meetings is required.* Absences may be excused due to illness or unexpected/unavoidable emergencies; students are expected to contact the instructor by email as soon as possible in the event of an emergency. Make-up lab sessions are unable to be offered.

## ASSESSMENT AND GRADING

***All work is to be completed individually unless otherwise specified.*** You must submit paper and/or electronic copies of homework and other written assignments by the specified time on the due date. **For full credit, all assignments must be submitted on time. The penalty for late assignments is 10% of the total score per 24-hour period past the deadline.** Due dates for assignments are listed in Canvas; these dates are subject to change. Do not ask for an individual extension to a due date because you have a paper due, or three exams, or your computer crashed; due dates are set so that you have plenty of time to complete your work. Don't wait until the night before to start - there is no penalty for starting early. ***It is your responsibility to plan ahead.***

Although in the real world there are often no excuses, you will be given a break on assignments due to circumstances that are truly beyond your control. *Alternative due dates will be worked out with the instructor on an individual basis.* Here are examples of **permissible reasons for a late submission**:

- A *serious* illness (flu is serious - upset stomach or case of the sniffles is not) or accident
- A *serious* family emergency or death (you are on your honor here)
- Other unusual circumstances may count also. For example, if the university closes due to flooding on the date the work is due.

Pre-lab exercises and Reflections are submitted in Canvas in "Quizzes": although there is no time limit for completing these, you are allowed a single submission. Please check Canvas for the Release/Due Dates; you must submit your work during this time frame to get full credit. *You must complete all of the pre-lab exercises ALONE* (i.e., do not work on the pre-lab with anyone else); you may use your class notes/web sites/etc.; have a calculator and pen/pencil with scratch paper on hand as you answer the questions.

**Course grade determination (*all work is to be completed individually unless otherwise specified*)**

- Project Proposal (Team) and Research Progress Report (Individual) 35%
- Journal Club Presentation (Team) 25%
- Laboratory Notebook (Team) 15%
- Lab Citizenship and Safety (Individual) 10%

- Engagement and Participation 10%
- Reflections and Surveys (Individual) 5%

The final weighting for each category is subject to change at the discretion of the instructor; after all assignments have been graded, the instructor may change the weighting to raise final course grades.

**Journal Club Presentation**: Teams will give a 20 minute presentation on a selected scientific article in synthetic biology.

**Project Plan / Project Proposal**: Before the first day of class, you will read some articles about synthetic biology and complete Reflections on "synthetic biology challenges." After discussions about these challenges, teams will 1) brainstorm a project idea and share with class; 2) choose a project for circuit design and DNA assembly; 3) build the circuit. Teams will propose their ideas in a scaffolded manner beginning with rationale and circuit abstraction (no writing), followed by refined rationale and circuit abstraction (writing), and ending with designs of circuits and assembly plan (primers, gblocks, circuit cartoon, etc.). You will write a **Research Progress Report (Individual)** about circuit idea.

## Communication Instruction

Both written and oral communication are emphasized in this course. As a team, you will maintain a laboratory notebook to academic standards (see description below and in Assignments). Ongoing verbal communication with your teammates during lab is essential for promoting a strong team dynamic and critical for completing the procedures in lab and analyzing the data.

We intend to use the overall quality of the laboratory notebook and your specific notebook entries to evaluate your effort. Describe all procedures that you perform in sufficient detail to repeat the experiment and record any raw data. Remember to describe any problems encountered or unexpected results.

See **Laboratory Notebook Guidelines.pdf**  and the **BIOC 313 Notebook Checklist.pdf**  for specific evaluation criteria. *Each team will maintain a single laboratory notebook - notebooks will be given to you on the first day of lab:*

- ***Each team member is expected to make daily entries in the notebook during each lab.*** A single team member must not, for example, act as a recordkeeper by writing in the notebook while the others carry out the work. You may want to take turns writing the *Objectives/Daily Summary* for each lab day. Take turns recording information during lab and initial at the end of each entry by a different member of the team. At the end of the session, remember to draw a line through any remaining blank spaces.
- When you finish for the day, record the time on the final page and draw a line through any remaining blank spaces.
- *It is absolutely critical that you record details such as WHO did WHAT (e.g., loading samples on the gel,*

*setting up PCR, etc.) and LABELS on your samples.* You must have this information in your notebook to determine where a procedural error(s) occurred and to use the correct sample for that day's procedures.

- Remember, **do NOT "pre-write" objectives or methods in your notebook BEFORE you come to lab.**
- *You must have a TA initial/date the LAST notebook page for each lab session BEFORE leaving lab EACH day.*

As a team, you will brainstorm circuit ideas and propose an idea in a scaffolded manner. As an individual, you will write a Research Progress Report at the end of the semester.

You are encouraged to make appointments with the peer consultants at the Center for Written, Oral, and Visual Communication (CWOVC) for your communication assignments in this course. These consultants do not proofread or edit your work, but they will provide feedback on topics such as the organization of your paper, the coherence of your argument, and appropriate sentence structure. NOTE: For this course you are NOT allowed to work with a consultant who is a biosciences major or to get any assistance with the content of the assignment. You can make an appointment at the Center's website: [cwovc.rice.edu](http://cwovc.rice.edu) (<http://cwovc.rice.edu/>). Please consult with Dr. Beason if you have any questions.

## Evaluation of Performance

We expect students to follow explicit instructions and to recall and apply previous training to each new project. Punctuality, safe conduct in the laboratory, and efficient completion of responsibilities will enter into the evaluation of overall performance. Read about our expectations and performance criteria in [lab citizenship\\_2017.pdf](#).

## HONOR CODE POLICY

All students will be held to the standards of the Rice Honor Code, a code that you pledged to honor when you matriculated at this institution. Consult the Honor System Handbook at <http://honor.rice.edu/honor-system-handbook/> (<http://honor.rice.edu/honor-system-handbook/>) for details about this code and how it is administered. This handbook outlines the University's expectations for the integrity of your academic work, the procedures for resolving alleged violations of those expectations, and the rights and responsibilities of students and faculty members throughout the process.

When you turn in an assignment, you must be able to make the statement, "On my honor, I have neither given nor received any unauthorized aid on this assignment." This pledge applies to notebook entries, pre-lab quizzes/exercises, homework assignments, section drafts, and the final paper. For detailed information, see the link on the course web site.

All pre-laboratory quizzes, homework, reflections, lab notebook, and writing assignments must represent

your individual work unless specified otherwise. You will perform lab work as teams and are encouraged to share responsibilities of data collection and analysis. While you may discuss data calculations with teammates, when you begin writing the paper, you should not work together on or share ideas about specific information to include in text, formatting and/or content of figures and tables. The Writing Center's mentors may be consulted about the clarity and quality of your writing; however, those mentors should focus on your writing without providing comments about scientific content. Additional honor code details for written assignments are included with the assignment. The following applies to all written assignments: No one is to have access to any other student's paper for this course, from this semester or from any previous semester. When assignments are prepared by teams, no team is allowed access to another person's or another team's written assignment as described above. Thus, it is both a violation to provide or post material not provided by the instructor or to use similar material for your own benefit. If you find that previous papers are posted on the web, kept in college libraries, or available in any other form, please report the suspected violation to the honor council.

## STUDENTS WITH DISABILITIES

Course material will be delivered either digitally (online or email) or in person and may be visual (written documents, slides, videos, etc.), audio (videos, presentations, discussions), or interactive (questions, discussions, clickers, etc.). Course work will require answering questions online, safely performing laboratory procedures, writing in lab notebooks, typing papers, reading written materials, discussing material with peers, and may include light lifting and sitting for extended periods of time. Some interactive portions of lectures will not be available online; thus, students should choose or request seating where they are best able to view and hear presented materials. Any student with a documented or suspected disability needing academic adjustments or accommodations is requested to contact the instructor in person or by email before the first day of class; all discussions will remain confidential. **Students with disabilities should also contact Alan Russell ([alan.g.russell@rice.edu](mailto:alan.g.russell@rice.edu) (<mailto:alan.g.russell@rice.edu>)), Director, Disability Support Services (713-348-5841) before the first day of class.**

*Information contained in this course syllabus, other than the absence policies, may be subject to change with reasonable advance notice, as deemed appropriate by the instructor.*